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| **An Old Chi Square Problem with a New Twist!**  To Accompany the Cell Division Lab, AP Biology, Ms. Ottolini  **Overview:** Our cell division experiment includes two independent variables (control solution vs. caffeine solution) and two dependent variables (cells in interphase vs. cells in mitosis). The problem given below has two independent variables (male vs. female) and only ONE dependent variable (# of animals). This set-up will provide a comparison to the cell division experiment Chi square analysis.  **Situation:** Naked mole rats are a burrowing rodent native to parts of East Africa[.](http://en.wikipedia.org/wiki/East_Africa) They have a complex social structure in which only one female (the queen) and one to three males reproduce, while the rest of the members of the colony function as workers. Mammal ecologists suspected that they had an unusual male to female ratio. They counted the numbers of each sex in one colony.  **Hypothesis:** There is a statistically significant difference between the number of males and females in the population  **Null Hypothesis:** There is no statistically significant difference between the number of males and females in the population. (In other words, the number of males and females in the population should be approximately EQUAL.)  **Table #1 – Table of Observed Values (o)**   |  |  | | --- | --- | |  | **# of Rats** | | **Female** | 52 | | **Male** | 36 | | **Total** | 88 |   **Table #2 – Table of Expected Values (e)**   |  |  | | --- | --- | |  | **# of Rats** | | **Female** | % of rats expected to be female X total # of rats = # of rats expected to be female  0.5 x 88 = 44 | | **Male** | % of rats expected to be male x total # of rats = # of rats expected to be male  0.5 x 88 = 44 | |
| **Table #3 – Calculation of Chi Square Value**   |  |  |  |  | | --- | --- | --- | --- | |  | **Observed (o)** | **Expected (e)** |  | | **Female** | 52 | 44 |  | | **Male** | 36 | 44 |  |   **Total of Right Column**  = X2 = 2.90 |

**Degrees of Freedom and Accepting or Rejecting your Null Hypothesis:**

When you have multiple independent variables (male vs. female) and one dependent variables (# of rats), you calculate the degrees of freedom using the following formula:

*(Note: “df” stands for “degrees of freedom” and “IV” stands for “independent variables”)*

Since we have two independent variables and only one dependent variables in this experiment, our df = (2-1) = 1.

To determine whether you accept or reject your null hypothesis, look up the X2 value at one degree of freedom at p=0.05 on the table given below. This X2 value is known as the critical value.



Since the X2 value that we calculated (2.90) is lower than the critical number (3.84), we can accept the null hypothesis. In other words, there is no statistically significant difference between the observed and expected results. (There is no significant difference between the number of males and females that we observe and the numbers that would be predicted by an equal percentage of males and females.)

*If the X2 value that we calculated was higher than the critical number, we would reject the null hypothesis. In other words, there would be a statistically significant difference between the observed and expected results. (There would be a significant difference between the number of males and females that we observed and the numbers that would be predicted by an equal percentage of males and females.)*